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Beta Calibration Manual

BETA 230/130

BETA
PRODUCTS

BETA PRODUCTS

BETACAL OPERATORS MANUAL

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BETA PRODUCTS

BetaCal Software Package

Index

	Page
General Description	1
Equipment Requirements:	1-3
Installation, Software	4-5
Customizing the Calibration Report	6-7
Program Operation	7
Configuration Options	8
Calibration Options:	9
A. Volts/Millivolts	10
B. Milliamps	10
C. Ohms	11
D. Frequency	11
E. Cold Junction Compensation	11-12
RS232 Serial Interface Figure 1	13
Calibration Reference Figure 2	14
Milliamp Calibration Figures 3, 3A, 3B	15-17
Ohms Calibration Figures 4A, 4B	18-19
Frequency Calibration Figures 5A, 5B	20-21
Cold Junction Compensation Calibration Figures 6A, 6B, 6C	22-24

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Addendum to Betacal3 Software Program

The calibration program was originally designed to be used in the automatic calibration mode with the HP3456A digital multimeter only. The program will now support use of the HP3458A in the auto mode.

Three files on disk will allow the user to configure for either meter. HP3456A.CFG , HP3458A.CFG , and DMM.CFG. The program looks for parameters in the file DMM.CFG to configure itself for use with either meter. Depending on which meter is to be used, the DMM.CFG should be edited to reflect the same values in HP3456A.CFG or HP3458A.CFG or simply rename the HPXXXA.CFG to be used as DMM.CFG

General Description

The BetaCal software package is used to perform field recalibration of the Beta 110, 210, 211, 130 and 230 series calibrators. The software runs on an IBM PC or compatible computer under the MS/DOS operating system. The BetaCal software allows the PC to act as an "electronic screwdriver" to perform testing and calibration of the Beta calibrator utilizing external, user supplied calibration references.

Equipment Requirements

Minimum Equipment Required

1. IBM PC or compatible computer.
2. 256K memory.
3. Floppy disk drive.
4. Asynchronous communications adapter configured as COM1:

Optional Equipment Supported

1. Hard disk drive.
2. 80 column printer for reports.
3. National Instruments GPIB-PC (IEEE-488) Interface.
4. Hewlett Packard 3456A digital volt meter.

Calibration Standards Required

1. Precision DC voltmeter.
2. Precision DC ammeter or precision shunt resistor for use with item 1 above.

3. Precision ohmmeter (for model 210/211/230 only).
4. Precision resistance decade box (for model 210/211/230 only).
5. Precision frequency reference OR frequency counter (for model 110/230 only).
6. Laboratory grade reference type J thermocouple (for model 210/211/230 only).

NOTE

The accuracy of the calibration references must be greater than the accuracy of the unit being calibrated by a factor of at least 2 and preferable a factor of 10.

The following is a list of recommended equipment that has been used with good results.

1. Hewlett Packard model 3456A digital voltmeter. This instrument may be used in the calibration of volts, millivolts and resistance simulation. With a suitable precision shunt resistor it can also be used to calibrate the milliamp output function.
2. Hewlett Packard Model 5316A universal counter. This instrument may be used in the calibration of the frequency function of the model 110.
3. General Resistance model RTD-100 decade box. This instrument may be used to calibrate the resistance measurement function of the model 210/211. It may also

be used as a precision shunt for the milliamp calibration.

4a. Fisher Scientific Model 15-041A thermometer. This instrument may be used to calibrate the reference junction sensing function of the model 210/211/230. It is NBS traceable and is graduated in 0.1 deg C increments.

4b. Laboratory grade type J thermocouple. This may be used with the ice bath to perform the reference junction of the model 210/211/230.

INSTALLATION

Software Installation

The following list of files should be on your BetaCal distribution diskette. The BetaCal software may be run from a floppy disk drive or installed on a hard disk drive.

BETACAL2.EXE	main program for calibrators with revision 02.xx software
BETACAL2.HLP	help and message text
BETACAL3.EXE	main program for calibrators with revision 03.xx software
BETACAL3.HLP	help and message files
HDR1.DAT	sample page 1 text files
HDR2.DAT	
STDUSED.DAT	
SIG.DAT	
INSTALL.BAT	installation batch file for hard disk installation
README.DOC	if present contains additions and changes to the manual

Hard Disk Installation

If you plan to run BetaCal from your hard disk, you can use the INSTALL batch file on the distribution disk to copy the proper BetaCal files to your hard disk.

[path] INSTALL src-drive: dst-drive:

Assuming that the BetaCal distribution disk was in the A: drive,

A:>INSTALL A: C:

would install the BetaCal on the C: drive. If you wish to have the BetaCal software in it's own directory, you should first make the directory and then change to that directory before

running INSTALL. For example:

MKDIR BETACAL
CHDIR BETACAL

Floppy Disk Installation

If you will be using BetaCal on a floppy disk based system, you should first make a working copy of the BetaCal distribution diskette and place the distribution diskette in a safe place. Use the copy for your normal use. If you want the BetaCal diskette to be a standalone bootable disk, format diskette with the /S option before copying the BetaCal files to it.

GPIB Installation

If you will be using the **HP3456A** on the **IEEE-488** interface with the National Instruments **GPIB-PC** interface card, you will need to install the hardware and software according to the instructions that accompanied the **GPIB-PC** card. The device driver **GPIB.COM** should be copied to the root directory of your boot disk and the **CONFIG.SYS** file should contain DEVICE=GPIB.COM The logical name of the **HP3456A** should be set to DVM.

Hardware Installation

Hardware installation consists of simply connecting the Beta Calibrator interface cable to the COM1: port of your computer.

The other end of the cable connects to the Beta Calibrator being calibrated. Figures 1 thru 6 show the diagrams for connecting the Beta Calibrator to the external calibration reference standards for the various calibration procedures.

Customizing the Calibration Report

The first page of the calibration report contains primarily user definable data. This includes the company name, general information, list of calibration standards, and a place for a signature. This information is read from standard ASCII text tiles that are prepared by the user using any standard ASCII text editor. The following suggested usage of these files is intended as a guide. The user is free to set up the format as he deems appropriate. If any file is not present, it is simply bypassed.

HDR1.DAT This is typically the company name and address and is printed at the top of the page.

HDR2.DAT This file typically contains general information about the nature of the calibration, its traceability, etc. It is printed after *HDR1.DAT* and after the model number, serial number, and date of calibration.

STDUSED.DAT This file typically contains a list of the calibration equipment used, its calibration dates, etc. It prints after *HDR2.DAT*

SIG.DAT This file typically contains the signature block. It is the last file to print on the first page. After *SIG.DAT* prints, a form feed is generated.

Printer control characters can be imbedded in the text files by using the 3 digit DECIMAL equivalent of the ASCII control character preceded by a backslash (\). For example, to print the company name in double width characters on an EPSON compatible printer you would issue the following commands:

\014_____ACME SERVICE COMPANY

To print a title in emphasized mode:

\027\069Calibration Equipment List\027\070

The \027 is the ASCII Escape character.

PROGRAM OPERATION

Starting The BetaCal Program

There are 2 versions of the BetaCal program. BETACAL2 is used to calibrate units with version 02.XX software. BETACAL3 is used to calibrate units with version 03.XX software. In general, the original calibrators that do not have the feature connector in the bottom of the case, use version 02.XX software. The newer calibrators that have the feature connector, use version 03.XX software. To determine the exact version of software in a calibrator, select the SETUP option for LCD viewing angle. The software revision is shown on the second line.

The program is started by entering the program name, BETACAL2, or BETACAL3, at the DOS prompt. The program is menu driven, with help screens available at each level.

Operation of The BetaCal Program

At the MAIN menu you can enter CONFIGURATION options, START a calibration, or EXIT the program.

Configuration Options

1. Calibrate Only - no reports are generated. A printer is not required.
2. Calibrate: As Left Report - First the calibrator is recalibrated, then a check of the calibration is done and a final report is generated.
3. As Found Report: Calibrate: As Left Report - First a check of the calibrator is done and a report is generated. Next the calibrator is re-calibrated, and finally a check of the calibration is done and a final report is generated.
4. As Found Report: Calibrate - Same as 3. above except no final report.
5. Report Only: No Calibration - A check of the calibrator is performed and a report is generated but the calibrator is not re-calibrated.
6. *GPIB AUTO* - This activates the *GPIB* interface to the *HP3456A* digital voltmeter to automate certain functions in the testing and re-calibration of the calibrator. Do not select this option unless you have a properly configured *GPIB/HP3456A* system.

7. Manual - This mode of operation allows any suitable precision standards to be used in the re-calibration process. The user will be prompted to enter values at the appropriate times from the external references.

Start a Calibration

This option starts the calibration process.

CAUTION:

Prior to starting a calibration, you must ensure that the remote interface is enabled in the calibrator being tested.

To enable the interface, enter the setup mode by pressing SETUP on the keyboard and select setup option MfgTst. You will then be prompted to enter the access code. Enter 2029 and then press ENTER. Press the UP ARROW key until the display shows Enabled, and then press ENTER and then SETUP. Now you may select the Start Calibration option. The program first establishes communication with the calibrator and retrieves the current calibration variables from the calibrator to be used in the re-calibration computations. If you want to re-calibrate additional calibrators, you must return to this portion of the menu before attaching another calibrator, otherwise the program will detect a serial number mismatch and abort the calibration.

Calibration Options

The first calibration menu allows you to pick which function

to calibrate; Volts, Milliamps, Ohms, Frequency, or Reference junction compensation. Note that not all functions are applicable to all models of the calibrators. If you attempt to specify a function that is not available on the calibrator that is being calibrated, the program will give an error message.

The Functions That Can Be Calibrated Are:

A. Volts/Millivolts. The DC voltage calibration affects the milliamp, ohms, and reference junction compensation. If the volts function is re-calibrated, the other functions MUST be re-calibrated since a change to the volts calibration will change the milliamps, ohms, and reference junction calibrations. There are 3 separate internal references for both the input and output section of the calibrator that will each be calibrated. Figure 2 shows the proper connections between the calibrator and the calibration references.

B. Milliamps. The milliamps calibration procedures vary since the model 110/130 has both milliamps input and output, and the model 210/211/230 have milliamps input only. When calibrating a model 110 or 130 the milliamp output, milliamp input and the external reference milliameter are connected in series per figure 3, and the model 110/130 is providing the milliamp source for the calibration. When calibrating a model 210/211/230, the milliamp

input, external milliamp source, and the reference milliammeter are connected in series. Since the external milliammeter is acting as the reference, the external milliamp source need not be precision. The only requirement is that the test current remain stable for the duration of the calibration which requires less than 1 minute. A small battery with an appropriate resistor in series will function quite nicely. See figure 3 A for an example. It is also possible to perform all milliamp calibration with a reference voltmeter and a shunt resistor. Figure 3B show an example of this technique.

C. Ohms. Input and output ohms must be calibrated separately since it is not possible to interconnect input ohms, output ohms and the reference ohmmeter. To calibrate input ohms, connect a precision reference resistor of between 400 and 500 ohms across the input ohms terminals in a 4 wire connection as shown in Figure 4A. Connect the ohms output terminals to the reference external ohmmeter using a 4 wire connection as shown in Figure 4B.

D. Frequency. The frequency input and output functions share a common time base so it is only necessary to calibrate one of the 2 modes. To calibrate frequency input, connect an accurate frequency source of between 1,000 and 100,000 hertz to the frequency input terminals (reference Figure 5A). To calibrate frequency output, connect the frequency output terminals to an

accurate frequency counter (reference Figure 5B). The calibrator will output a 10,000 hertz test signal at a 1 volt level.

E. Reference Junction Compensation.

1. Background. The thermocouple reference junction compensation has gone thru several changes in the never ending quest for higher accuracy. The original 210/211 calibrators employed an internal sensor located at the TC output jacks. This seemed to be the optimum location since the primary application is to simulate (output) thermocouples. Having the TC compensation built into the unit also eliminated having external modules to keep track of. Problems resulted due to the difficulty of making the actual TC to copper junction at the recessed jack. Since the actual junction was outside of the case and the temperature sensor was inside the case, errors would exist until the calibrator was allowed to stabilize at the ambient temperature ; this could take up to ½ hour. The original 210/211 can be recognized by not having a recessed sub-mini phone jack on the keypad between the input and output jacks.

To improve response time and accuracy, the temp sensor was moved to the outside of the case and mounted in an adapter module that allowed the temperature of the TC to copper junction to be measured more accuractely and quickly. Since the external TC module contained no calibration circuitry of it's own, each module was serialized and calibrated to it's individual calibrator. This caused problems if the TC module was lost or if

TC modules from different calibrators were interchanged accidently. The modified 210/211 with external TC compensation can be recognized by having a recessed sub-mini phone plug between the input and output jacks.

When the calibrators were re-designed in late 1988, it was decided to combine the best of all the TC methods. An internal temp sensor was used at the TC output jacks for convenience and general purpose use in normal ambient environments. An optional external TC reference junction is provided for use under various ambient temps that is interchangeable between different 210/211/230 calibrators. The re-designed 210/211/230 can be recognized by the 14 pin feature connector located at the front of the unit in the gold band of the case.

2. Calibration Methods. The calibration methods remain the same in concept for each model but vary somewhat in implementation. The reference junction compensation menu provides for 2 methods of calibrating the reference junction, and a method of calibrating the 210/211/230 to the new interchangeable external TC junction.

Method 1 requires that the TC reference junction temperature be measured with a thermometer and the temperature entered when requested by the program.

For the original 210/211 with internal compensation, the temperature should be measured at the output TC jacks.

For the modified 210/211 with the individual external TC modules, the temp should be measured at the TC module binding posts.

For the re-designed 210/211/230, the temperature should be measured at the output TC jacks to calibrate the internal sensor. The external sensor is calibrated separately.

Method 2 requires a reference grade type J TC and an ice bath.

For the original 210/211 with internal compensation, the thermocouple is attached to the TC input jacks as close as possible to the recessed jack. A screw down minature jack is recommended.

For the modified 210/211 with the individual external TC modules, the thermocouple is attached to the adapter module binding posts.

For the re-designed 210/211/230 the procedure is the same as the original 210/211 to calibrate the internal sensor. The external sensor is calibrated separately.

The third menu item under reference junction calibrations, is to calibrate the re-designed 210/211/230 to the interchangeable external TC reference module.

The temperature sensor utilized in the 210/211/230 outputs ua/°K with a nominal value of 298+/-2ua at 25°C. The module is trimmed to 301.0ua at 25°C to permit interchangeability. The 210/211/230 is calibrated for the external TC modules by applying a 301.0 +/-.05 ua signal to the external TC jack to allow calibration. See Figure 6C.

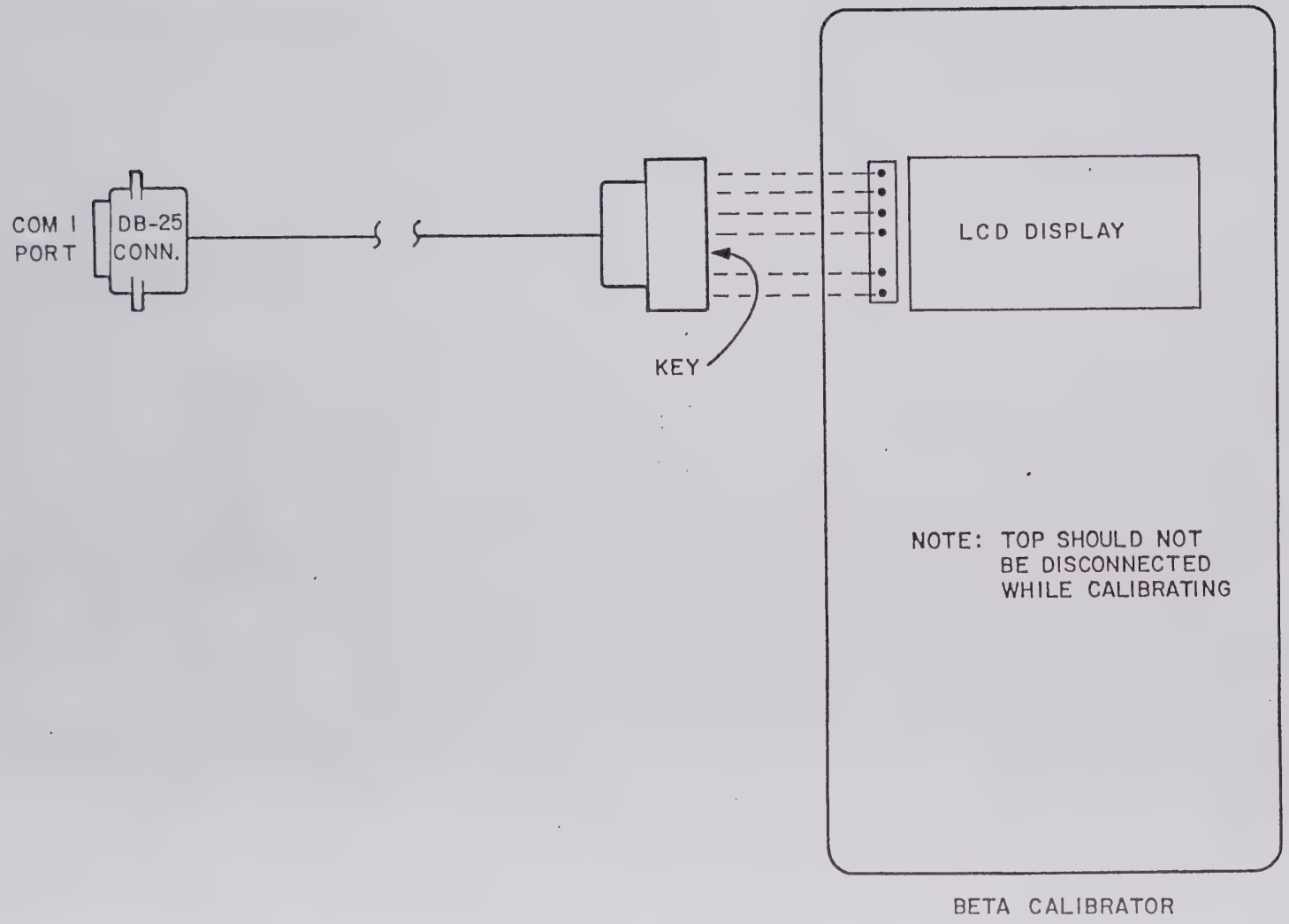

COM 1
PORT
DB-25
CONN.
KEY
LCD DISPLAY
NOTE: TOP SHOULD NOT
BE DISCONNECTED
WHILE CALIBRATING
BETA CALIBRATOR

FIG. 1

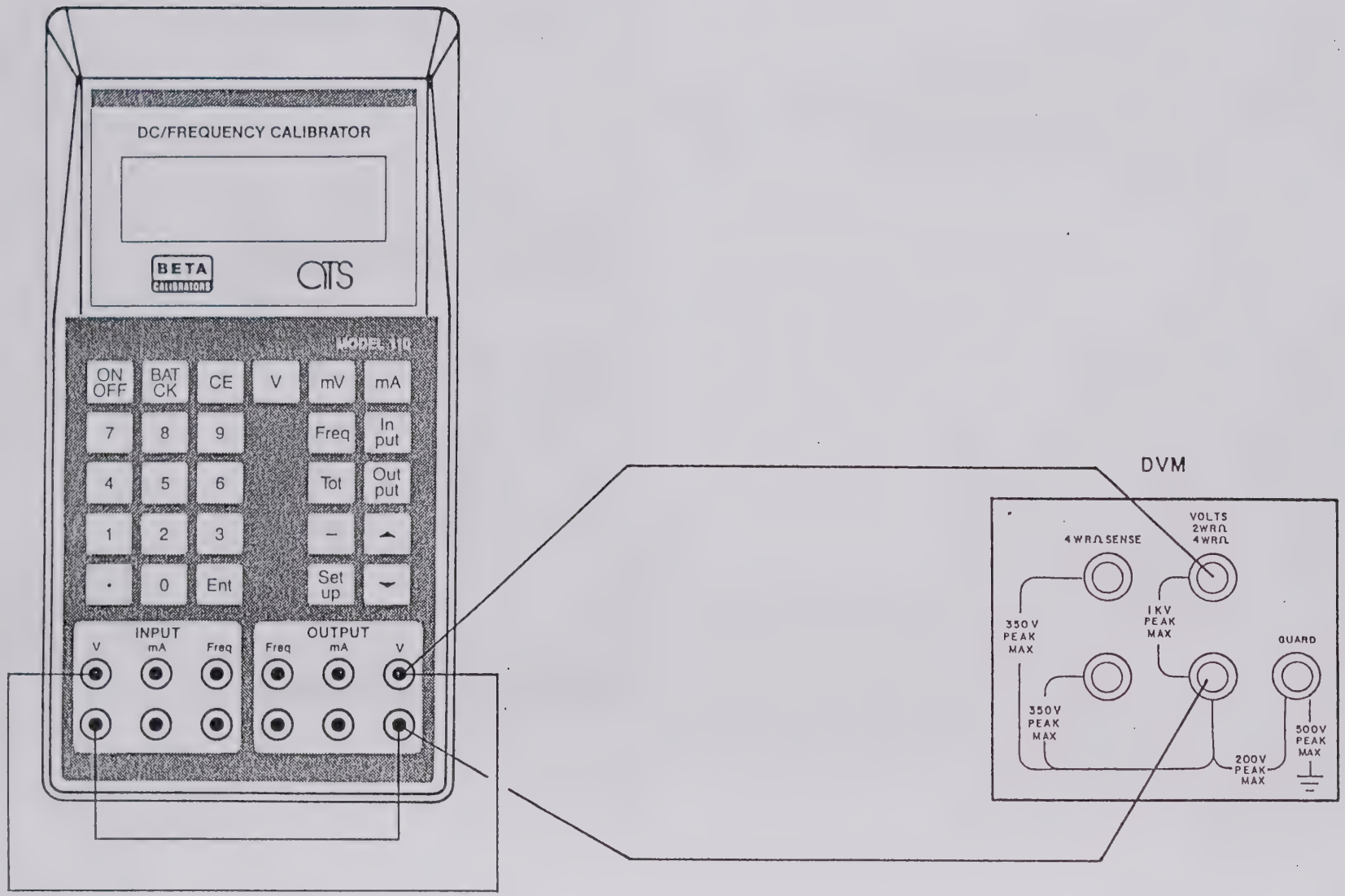

DC/FREQUENCY CALIBRATOR
BETA CALIBRATIONS
CTS
MODEL 110
ON OFF
BAT CK
CE
V
mV
mA
7
8
9
Freq
In put
4
5
6
Tot
Out put
1
2
3
–
0
Ent
Set up
INPUT
V
mA
Freq
OUTPUT
Freq
mA
V
DVM
4WRΩ SENSE
VOLTS 2WRΩ 4WRΩ
350V PEAK MAX
1KV PEAK MAX
GUARD
350V PEAK MAX
200V PEAK MAX
500V PEAK MAX

FIG. 2

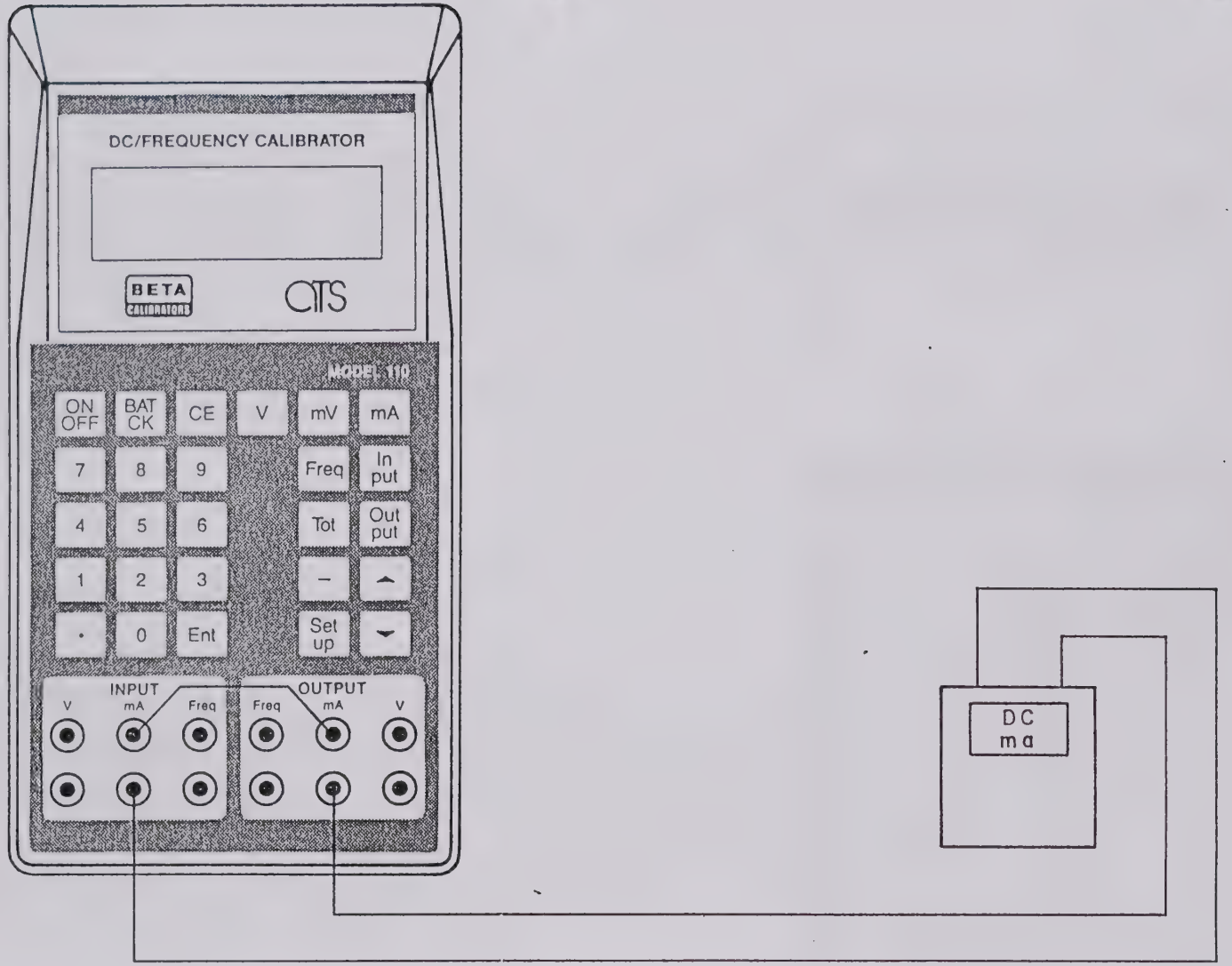

DC/FREQUENCY CALIBRATOR
BETA CALIBRATIONS
CTS
Model 110
ON OFF
BAT CK
CE
V
mV
mA
7
8
9
Freq
In put
4
5
6
Tot
Out put
1
2
3
–
•
0
Ent
Set up
INPUT
V
mA
Freq
OUTPUT
Freq
mA
V
DC
ma

FIG. 3

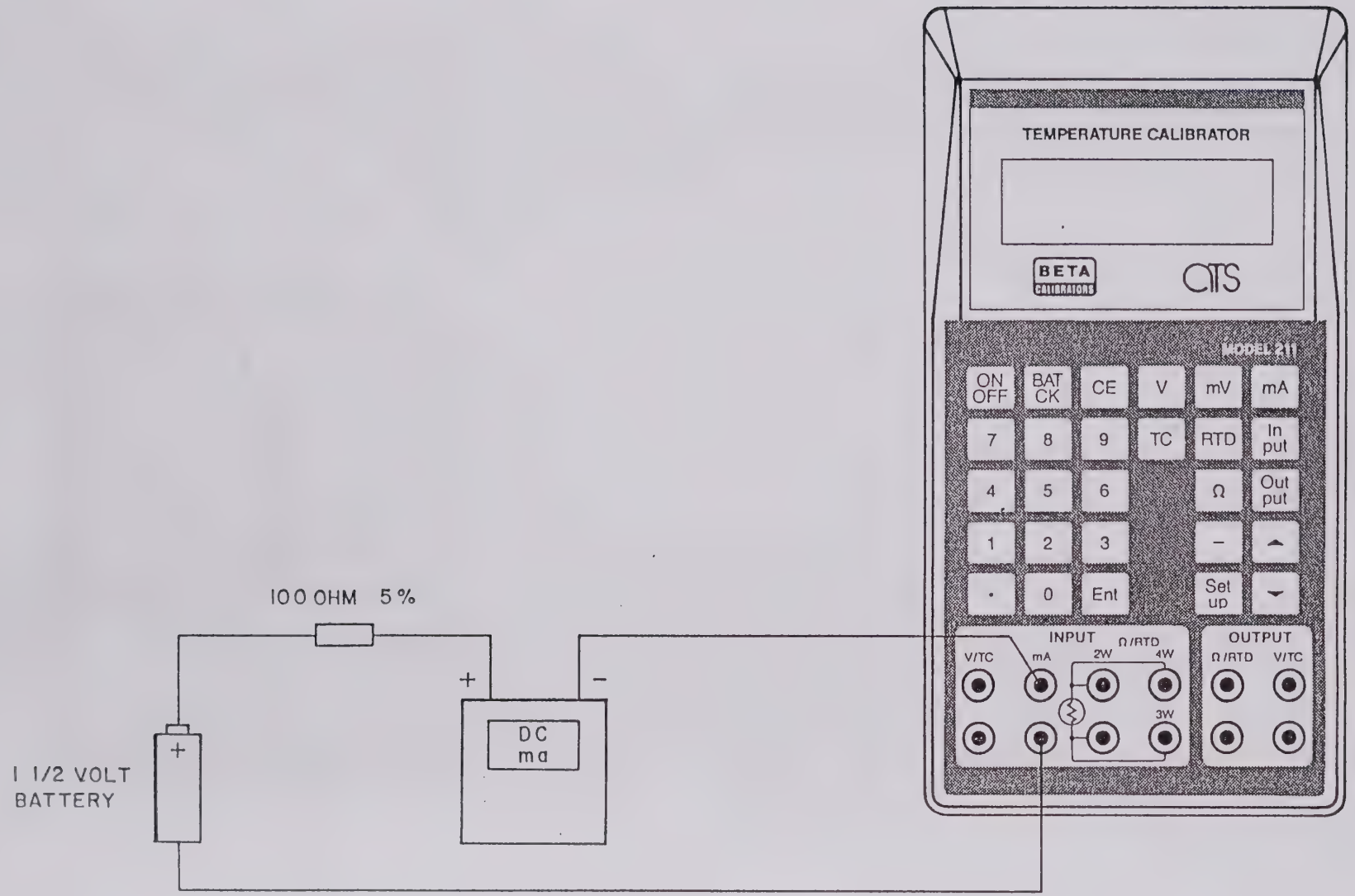

TEMPERATURE CALIBRATOR
BETA CALIBRATIONS
CTS
MODEL 211
ON OFF
BAT CK
CE
V
mV
mA
7
8
9
TC
RTD
In put
4
5
6
Ω
Out put
1
2
3
–
0
Ent
Set up
INPUT
Ω/RTD
V/TC
mA
2W
4W
3W
OUTPUT
Ω/RTD
V/TC
100 OHM 5%
+
–
DC ma
1 1/2 VOLT BATTERY

FIG. 3A

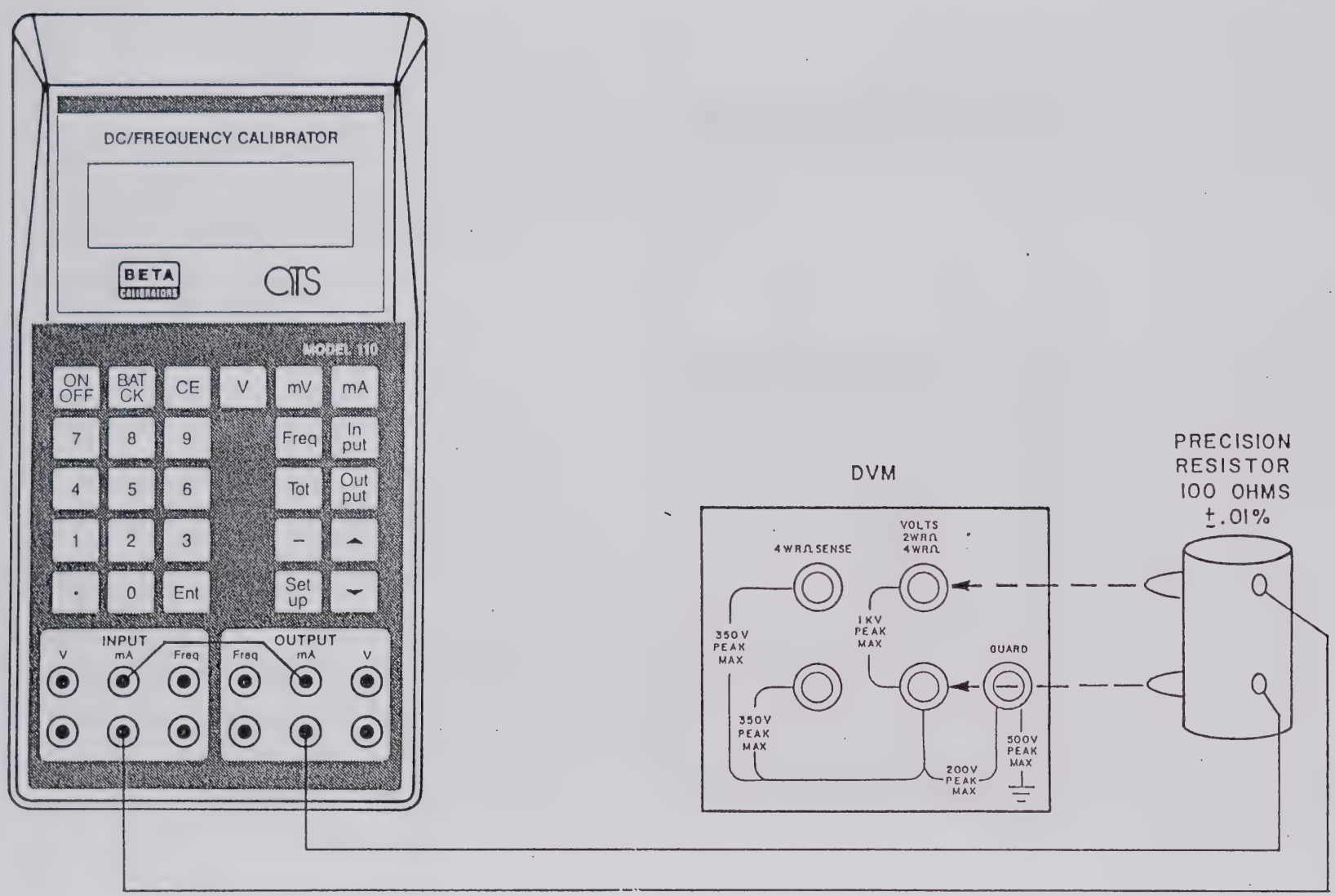

DC/FREQUENCY CALIBRATOR
BETA CALIBRATIONS
CTS
MODEL 110
ON OFF
BAT CK
CE
V
mV
mA
7
8
9
Freq
In put
4
5
6
Tot
Out put
1
2
3
–
▲
.
0
Ent
Set up
▼
INPUT
V
mA
Freq
OUTPUT
Freq
mA
V
DVM
4WRΩSENSE
VOLTS 2WRΩ 4WRΩ
350V PEAK MAX
1KV PEAK MAX
GUARD
350V PEAK MAX
200V PEAK MAX
500V PEAK MAX
PRECISION RESISTOR 100 OHMS ±.01%

FIG. 3B

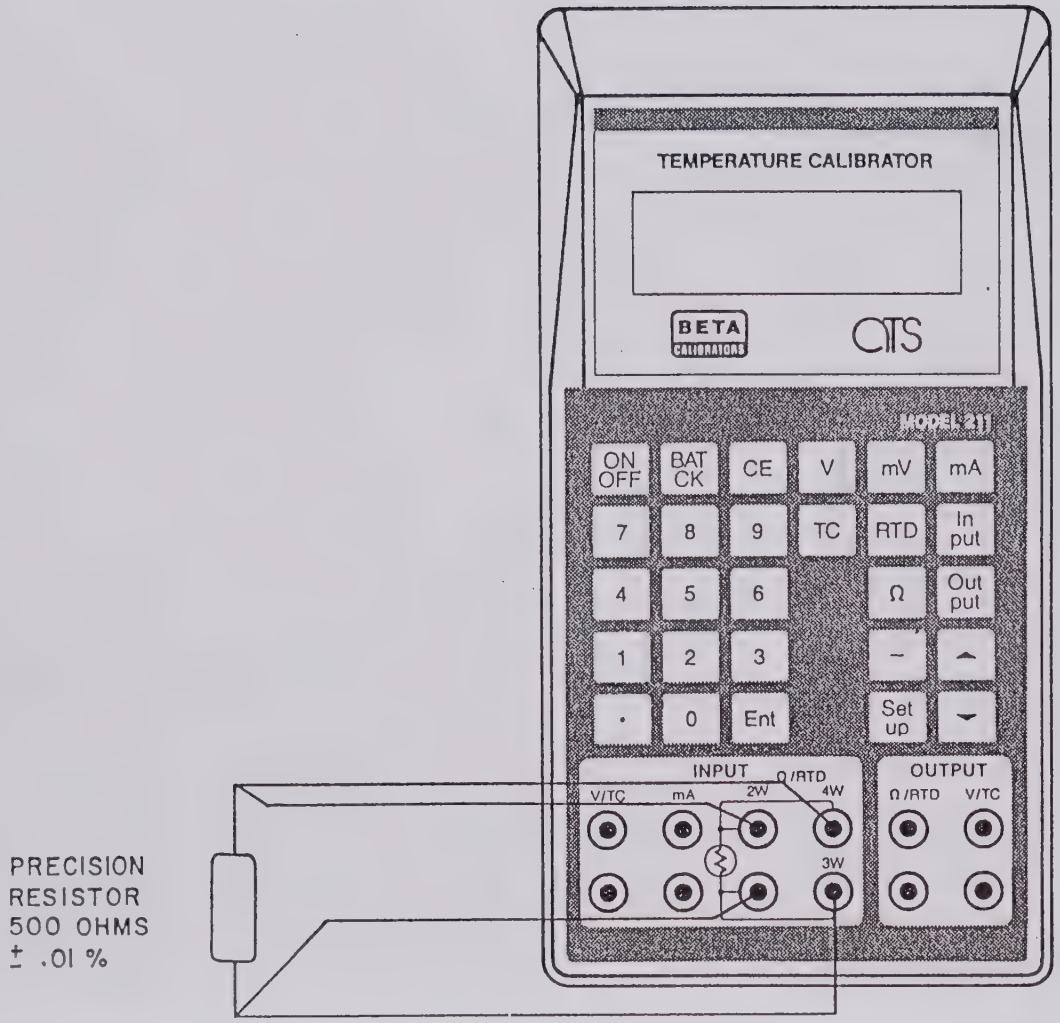
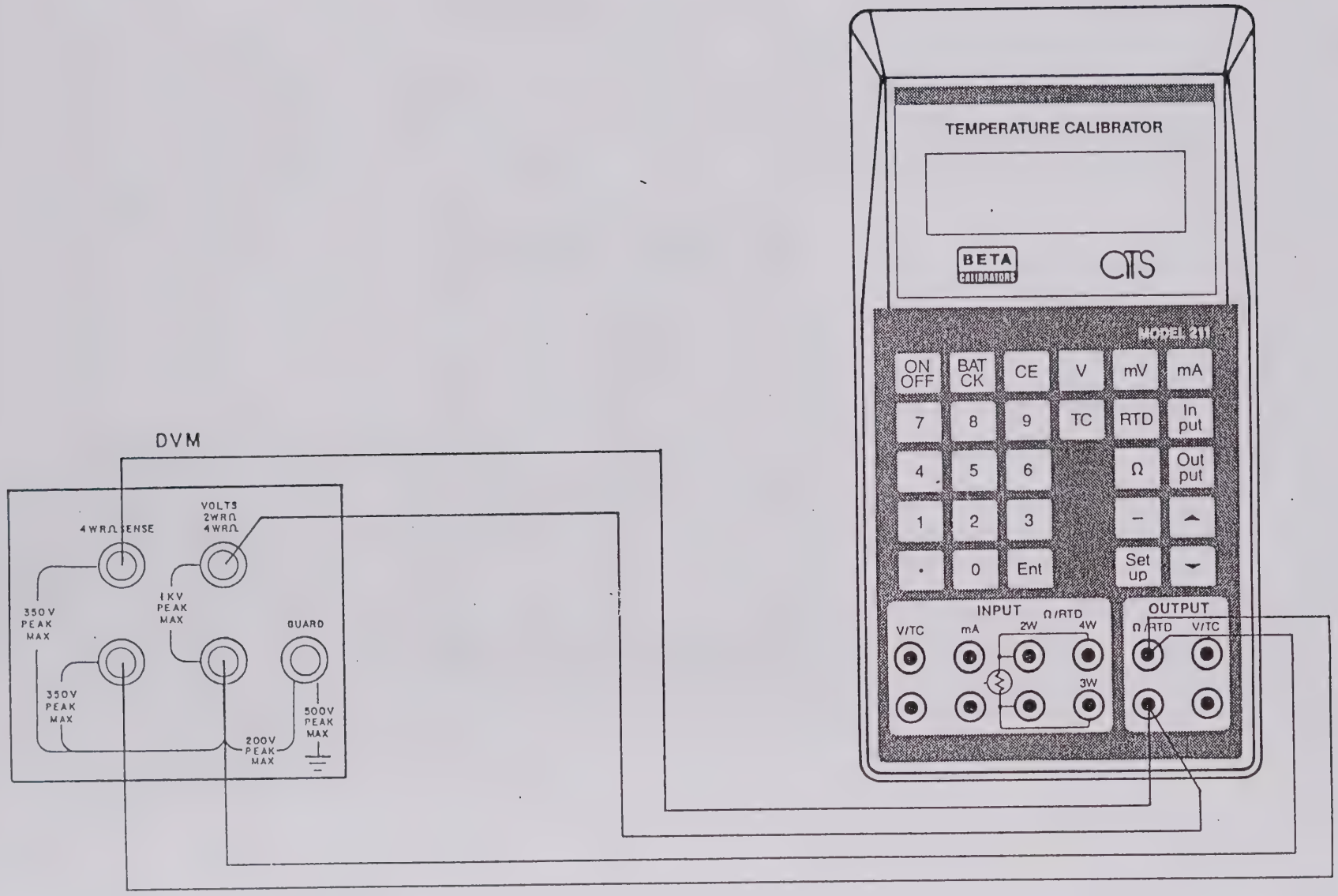

TEMPERATURE CALIBRATOR
BETA CALIBRATIONS
CTS
MODEL 211
ON OFF
BAT CK
CE
V
mV
mA
7
8
9
TC
RTD
In put
4
5
6
Ω
Out put
1
2
3
–
0
Ent
Set up
INPUT
V/TC
mA
2W
Ω/RTD
4W
3W
OUTPUT
Ω/RTD
V/TC
PRECISION
RESISTOR
500 OHMS
± .01 %

FIG. 4A



NOTE: REVERSED POLARITY WILL BE INDICATED IF APPROPRIATE.

FIG. 4B

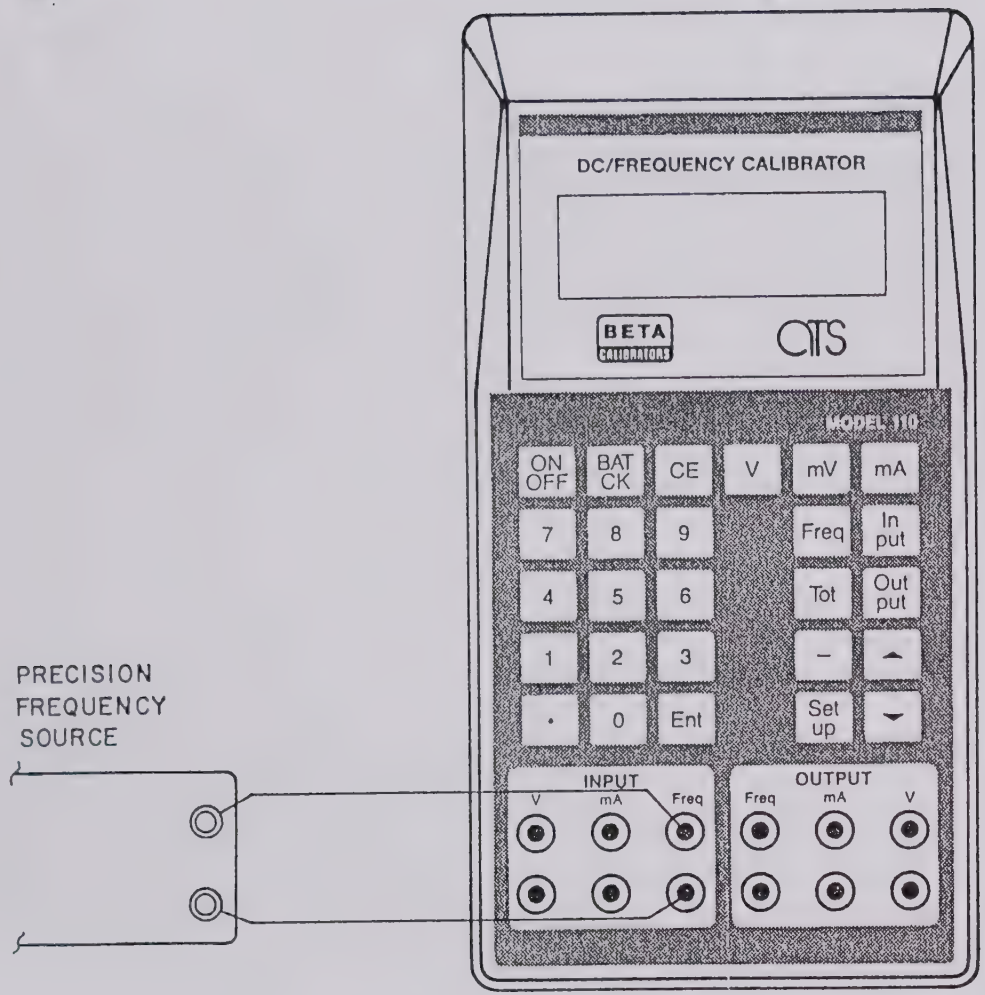

DC/FREQUENCY CALIBRATOR
BETA CALIBRATIONS
CTS
MODEL 110
ON OFF
BAT CK
CE
V
mV
mA
7
8
9
Freq
In put
4
5
6
Tot
Out put
1
2
3
–
•
0
Ent
Set up
INPUT
V
mA
Freq
OUTPUT
Freq
mA
V
PRECISION FREQUENCY SOURCE

FIG. 5A

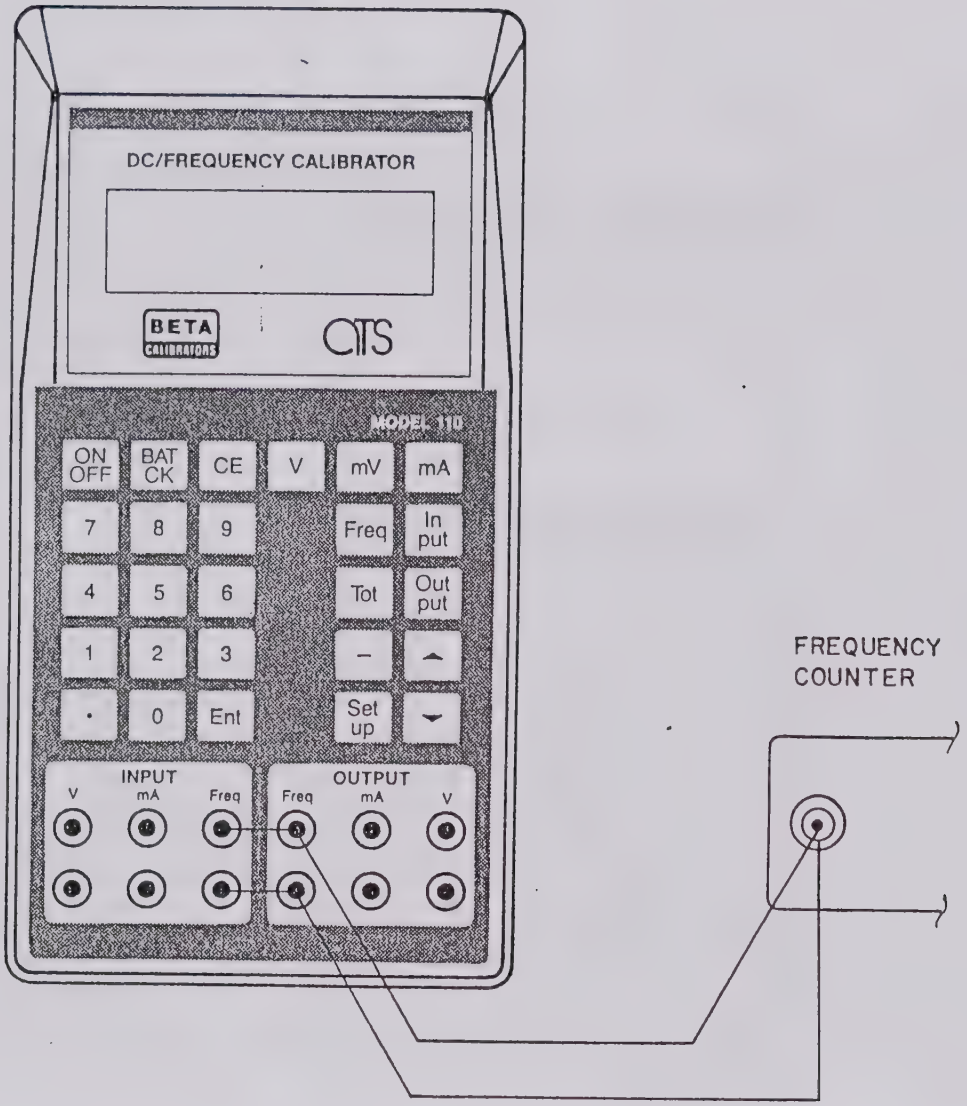

DC/FREQUENCY CALIBRATOR
BETA CALIBRATORS
CTS
MODEL 110
ON OFF
BAT CK
CE
V
mV
mA
7
8
9
Freq
In put
4
5
6
Tot
Out put
1
2
3
–
•
0
Ent
Set up
INPUT
V
mA
Freq
OUTPUT
Freq
mA
V
FREQUENCY COUNTER

FIG. 5B

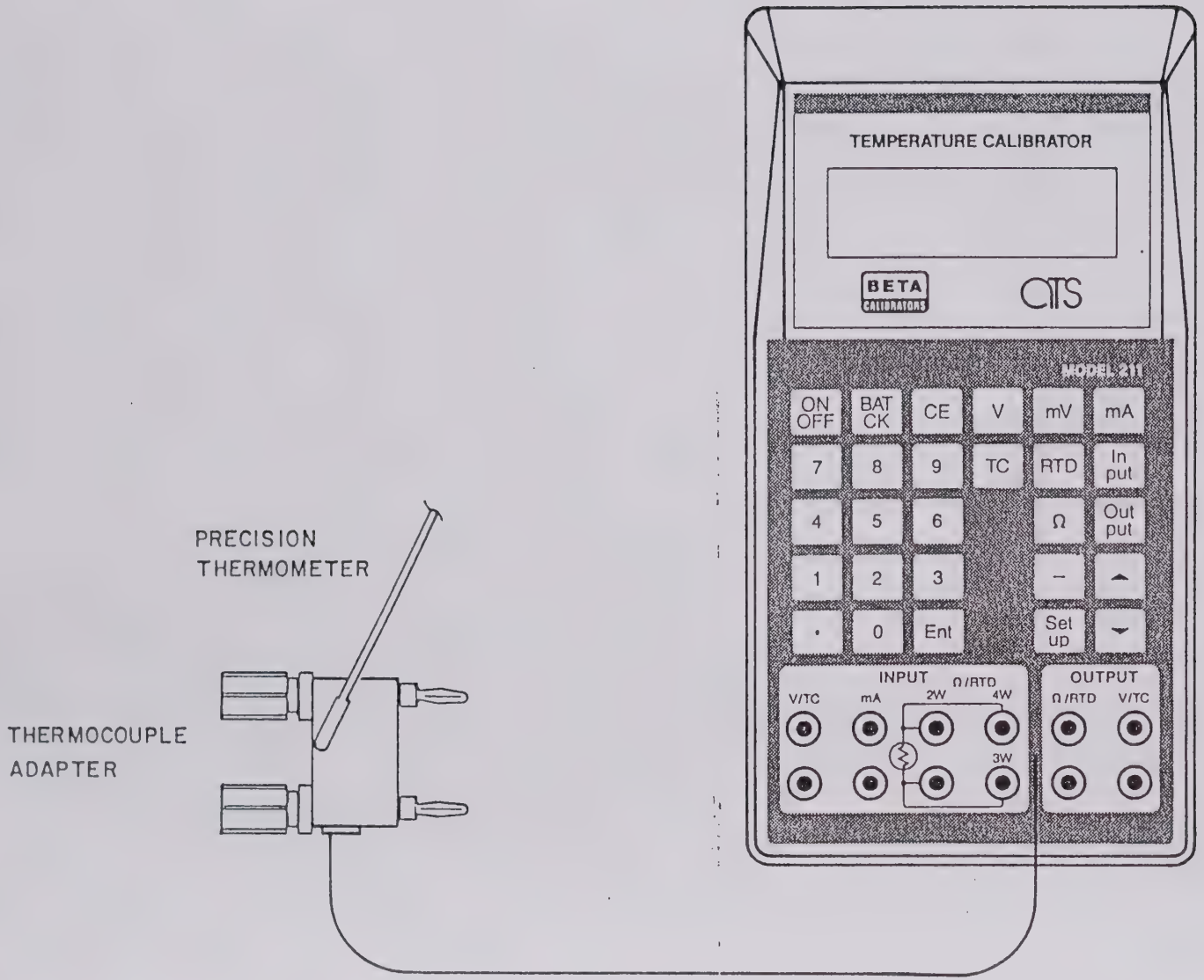

TEMPERATURE CALIBRATOR
BETA CALIBRATORS
CTS
MODEL 211
ON OFF
BAT CK
CE
V
mV
mA
7
8
9
TC
RTD
In put
4
5
6
Ω
Out put
1
2
3
–
•
0
Ent
Set up
INPUT
Ω/RTD
V/TC
mA
2W
4W
3W
OUTPUT
Ω/RTD
V/TC
PRECISION THERMOMETER
THERMOCOUPLE ADAPTER

FIG. 6A

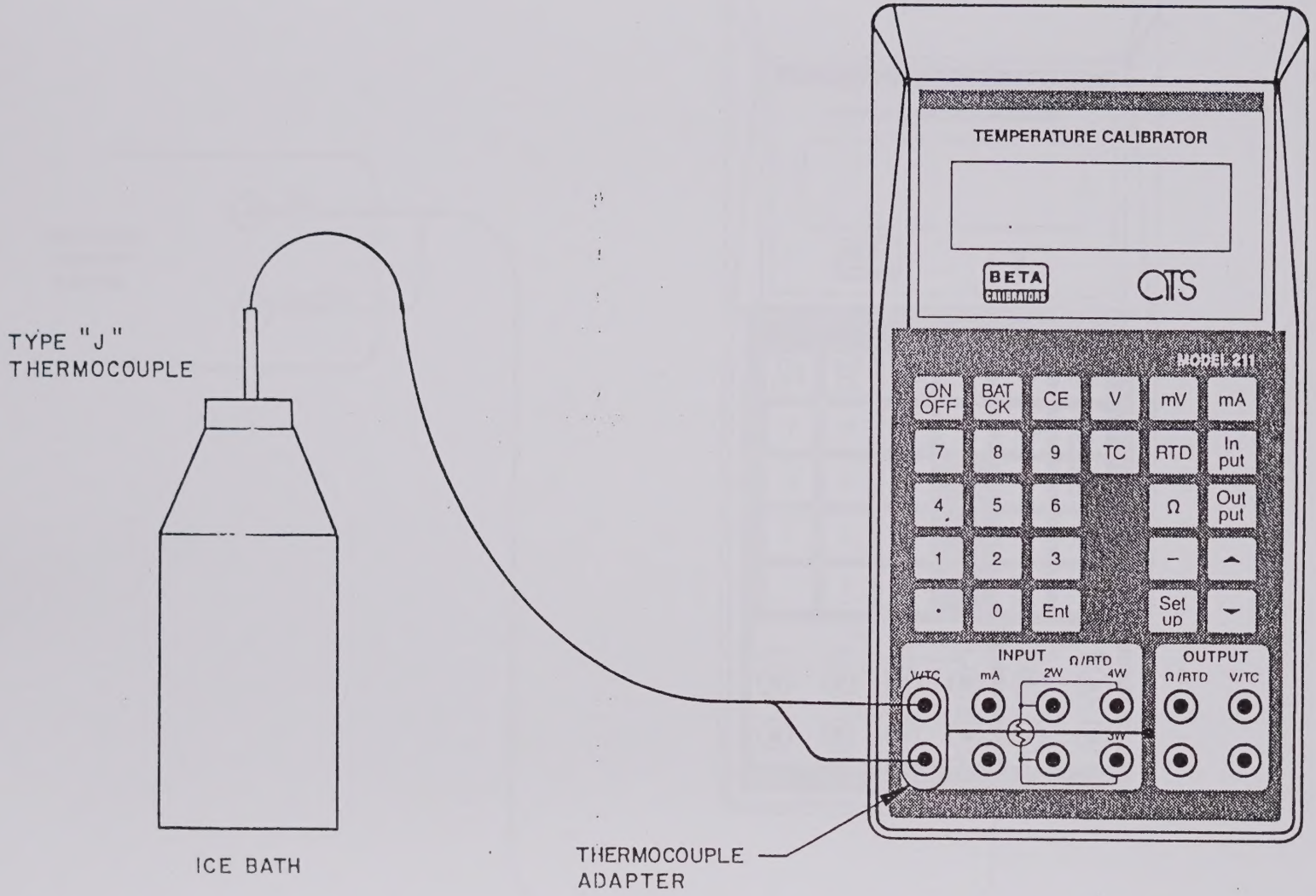

TYPE "J"
THERMOCOUPLE
ICE BATH
THERMOCOUPLE
ADAPTER
TEMPERATURE CALIBRATOR
BETA
CALIBRATIONS
CTS
MODEL 211
ON
OFF
BAT
CK
CE
V
mV
mA
7
8
9
TC
RTD
In
put
4
5
6
Ω
Out
put
1
2
3
–
•
0
Ent
Set
up
INPUT
Ω/RTD
V/TC
mA
2W
4W
3W
OUTPUT
Ω/RTD
V/TC

FIG. 6B

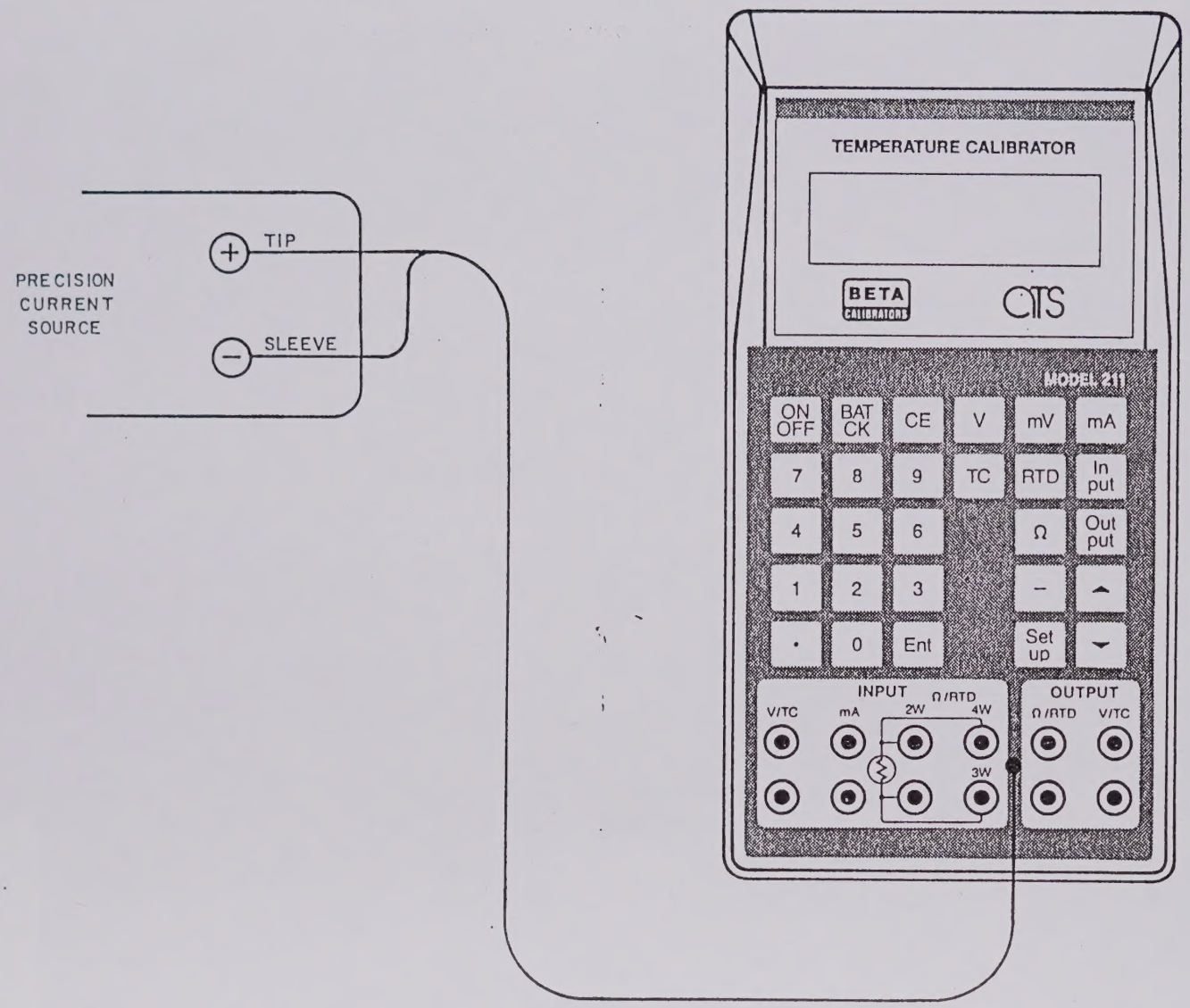

PRECISION
CURRENT
SOURCE
TIP
SLEEVE
TEMPERATURE CALIBRATOR
BETA
CALIBRATORS
CTS
MODEL 211
ON
OFF
BAT
CK
CE
V
mV
mA
7
8
9
TC
RTD
In
put
4
5
6
Ω
Out
put
1
2
3
–
•
0
Ent
Set
up
INPUT
Ω/RTD
V/TC
mA
2W
4W
3W
OUTPUT
Ω/RTD
V/TC

FIG. 6C

MP MASTER
MA22005